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COMMITTEE ON PAPERS AND PUBLICATIONS:

A. C. HALE,
J. F. GEISLER,
A. A. BRENEMAN, Editor.

ABSTRACTOR FOR AMERICAN PATENTS:

J. F. GEISLER.

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The **Journal of the American Chemical Society** appears monthly, except during July and August. It will contain all papers read before the Society, and a list of American Patents relating to Chemical Industries.

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The Meeting Room of the Society is the Law Lecture Room, University Building, Washington Square, New York.

The Regular Monthly Meeting is held on the first Friday of every month, except July and August, at 8 P. M.

Corresponding Secretary:

A. C. HALE, 551 Putnam Ave., Brooklyn, N. Y.

Treasurer:

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The Library of the Society in the Library Room of the University of the City of New York, is accessible daily, from 10 A. M. to 5 P. M., on Tuesday and Wednesday evenings, and on the evenings of the regular monthly meetings of the Society.

Back numbers of the Journal are sold to Members at $3.00, to others at $5.00, per volume. Apply to the Librarian,

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The Committee on Papers and Publications respectfully call attention to the resolutions of the Society, requiring that papers be submitted to the Committee before being read.

Authors will be furnished, gratis, with 20 reprints of each article published in the Journal, *if application for the same be made when the article is sent.*

Members are requested to give notice of any change of address, or failure in the delivery of the Journal. All communications relating to the Journal should be addressed to the Editor.

A. A. BRENEMAN, 97 Water St., New York.

NOVEMBER MEETING, Nov. 4th, 1892.

The regular meeting was called to order at 8:30 p. m. in the Law Lecture Room of the University. Prof. A. A. Breneman in the chair.

The minutes of the preceding meeting were read and accepted.

The following members were elected:

Frank N. Atwood, N. Y. Tartar Co., Brooklyn, N. Y.

Isador DePauw, H. W. Johns Mf'g Co., foot of 39th St., Brooklyn.

Prof. L. W. Andrews, Univ. of Iowa, Iowa City, Iowa.

Joseph Kessling, 525 W. 24th St., N. Y.

Prof. M. D. Sohon, Lehigh Univ., South Bethlehem, Pa.

Associate member.

Chas. S. Bush, Providence, R. I.

The Corresponding Secretary reported that the vote by mail on the new constitution had resulted as follows: 153 in favor of the constitution, 4 against, 3 in favor excepting certain sections, 1 ambiguous.

The members present who had not voted were given an opportunity to do so.

The chair then announced the new constitution as accepted.

It was moved and seconded that the report on spelling and pronunciation of chemical terms be referred to the council to report at the General meeting at Rochester.

The Society was then adjourned.

DURAND WOODMAN,
Recording Secretary.

THE ALBUMINOIDS OF MAIZE.

By Dr. George Archbold.

Under this heading it was my first intention to have read an elaborate paper on the subject; but time and circumstances at my command are such that this must be considered only preliminary; inasmuch as it involves a very important feature in the manufacture of starch from maize. According to published analyses of average corn which is used in the 22 principal factories engaged in the manufacture of starch, the total albuminoids consist of ten and one-half per cent. of the maize. This includes what is commonly known as gluten, or nitrogen-yielding products. In the usual methods of making corn starch, it has been found advisable to macerate the corn under water at varying temperatures, with a view of softening the corn, and at the same time putting it in such a condition that it can be ground into a pulpy mass, and that all except the cellulose can be disintegrated from the mass. It will be obvious that a certain amount of the albuminoids will escape a sieve or any mechanical method of separation. It will also be understood that the time required, varying from three days to a week, for the softening of the grain in question requires a temperature sufficient to resolve anything of an albuminoid nature itself into further compounds of a very complex nature. In view of these facts, I have tried to find by direct investigation of the pure corn whether or not these albuminoids have undergone a decomposition that would entitle me to form a true hypothesis of the solution in question. With this purpose, I have taken corn recently ground and reduced it to an impalpable powder, and have placed it in a sealed box and forced water into it, until the extract that came from it showed nothing upon evaporation in a platinum dish except the salts existing in the water and a portion of the soluble

salts that existed in the maize. This being done all at a temperature not exceeding 70° F., I have taken the total aqueous extract, which was neutral to litmus paper, and added alkali to it, which precipitated a flocculent mass, giving 16.7% of nitrogen. When this was collected and dried in the air, it gave many of the properties of diastase. The magma that was in the box above referred to, by which I made the extraction under pressure with water at 70° F., was further ground so that all except the cellulose would go through an 80 mesh sieve, by repeated washings at 70° F.; or until the magma contained nothing but pure cellulose, thereby having all that passed through the sieve in a state of suspension, namely the starch and the albuminoids contained in the corn treated that were soluble in water. I now added by degrees to the total that had gone through the sieve a solution of caustic soda of a gravity of 8° until it gave a coloration of a greenish yellow color. This was done in a beaker, and the result was that a flocculent precipitate of a brownish green color fell to the bottom, and the starch was held in suspension in the upper strata of the liquid. Unless sufficient alkali is added the starch will fall to the bottom. I drew off by the usual methods of siphoning and by a repeated washing with distilled water and obtained the starch practically pure. But this water when mixed together from the several washings of starch, contained an albuminoid, precipitated on neutralizing with hydrochloric acid as a light brown substance which, when dried at 212° F., or until it ceased to lose weight, gave 18% of nitrogen. The starch was practically pure. The substance underneath the strata of suspended starch which I have mentioned above, was of a greenish color, and contained only a small percentage of nitrogen. It appeared to be in part an insoluble soap, and contained most of the oils contained in the corn. Supposing that I had taken corn or maize from the steeps, and separated the starch by the means herein set forth, I would obtain different results and be able to gain nearly the same amount of nitrogen but would also separate substances of albuminoid nature, that I will submit to this Society later on. Now, under these circumstances, when commercial maize in the dried state, such as I submit herewith, is taken, and when the

experiments are carried out as I have stated, it will be found that only two definite albuminoid substances are obtained, one of which is thrown down by alkalies as a greenish precipitate, and the other soluble in alkalies, which precipitate is of a greenish color (except ammonia, which yields a white precipitate) and precipitated by acids. By the most careful methods used in various factories, the whole of the albuminoids that are soluble in alkali are never entirely washed out as will be shown in the various colorations in the starches found in the American market, which show the variation in composition.

No.	Pure Starch.	Fibre.	G uten.	Ash.	Moisture.	Total.	Mean Polariscopic Observation.	MINERAL	
								Calcium Carbonate	Calcium Phosphate
1	96.250	None	None	0.098	3.650	100.000	96°.2+	0.090	0.008
2	95.821	None	None	0.100	4.079	100.000	95°.8+	0.100	------
3	88.000	0.100	None	0.420	11.480	100.000	87°.9+	0.223	0.008
4	89.250	0.110	0.200	0.400	10.040	100.000	89°. +	0.221	0.018
5	88.230	0.381	0.400	0.400	10.589	100.000	87°.9+	0.221	0.008
6	88.000	0.110	0.190	0.200	11.500	100.000	87°.9+	0.091	0.008
7	88.010	0.201	0.099	0.700	10.990	100.000	87°.5+	0.500	0.013
8	87.901	0.750	0.249	0.600	10.500	100.000	87°.8+	0.380	0.018
9	88.210	0.220	0.201	0.800	10.569	100.000	87°.9+	0.421	0.020
10	87.561	0.439	0.100	0.400	11.500	100.000	87°.3+	0.200	0.008
11	87.200	0.310	0.190	0.200	12.100	100.000	87°. +	0.090	0.010
12	87.000	0.150	0.050	0.400	12.400	100.000	87°. +	0.200	------
13	87.000	0.250	-----	1.600	11.150	100.000	87°. +	1.311	0.012
14	87.000	0.327	0.423	1.000	11.250	100.000	87°. +	0.822	0.018
15	86.920	0.750	0.280	0.800	11.250	100.000	86°.9+	0.621	0.008
16	86.725	0.211	0.198	0.620	12.246	100.000	86°.5+	0.420	0.018
17	86.500	0.721	0 280	0.800	11.699	100.000	86°.5+	0.590	0.018
18	86.520	0.750	0.110	1.120	11.500	100.000	86°.4+	0.801	0.013
19	87.260	0.421	0.480	0.600	11.239	100.000	87°. +	0.360	0.017
20	87.260	0.300	0.381	0.600	11.459	100.000	87°. +	0.321	0.016
21	87.520	0.330	0.410	1.400	10.340	100.000	87°. +	0.831	0.020
22	87.253	1.010	0.912	1.549	9.276	100.000	86°.9+	1.251	0.011
23	86.900	0.211	0.150	1.100	12.639	100.000	85 .5+	0.621	0.118
24	86.821	0.411	0.519	1.000	11.249	100.000	86°. +	0.721	0.018
25	86.250	0.221	0.301	1.000	12.228	100.000	86°. +	0.681	0.013
26	86.225	0.120	0.555	1.000	12.100	100.000	86°. +	0.725	0.014
27	86.225	1.100	0.325	1.100	11.250	100.000	85°.5+	0.791	0.081
28	87.110	0.501	0 389	1.479	10.521	100,000	87°. +	1.010	0.081
29	87.234	1.100	0.481	0.800	10.385	100.000	86°.8+	0.541	0.021
30	87.210	0.110	0.210	1.000	11.470	100.000	87°. +	0.762	0.018
31	87.250	0.110	0.009	0.800	11.831	100 000	87°. +	0.521	0.018
32	87.110	0.230	0.331	0.400	11.929	100.000	85°.2+	0.158	0.018
33	86.521	0.933	0.216	0.800	11.530	100.006	85°.9+	0.530	0.011
34	85.430	1.120	0.800	1.400	11.250	100.000	84°. +	0.922	0.019
35	82.250	1.120	0.750	1.510	14.370	100.000	82°. +	0.821	0.080

MIXED STARCHES.

No.	Starch.	Fibre.	Gluten.	Borax.	Soda.	Calcium Carbonate	Moisture.	Stearine.	Total.
1	85.230	0.220	0.321	2.003	0.249	0.351	11.629	----	100.000
2	65.221	0.530	0.389	21.350	0.320	0.330	11.339	0.521	100.000
3	79.225	0.811	0.331	1.959	0.110	0.331	16.713	0.520	100.000
4	80.250	0.521	0.430	2.275	0.225	0.500	14.239	0.560	100.000
5	79.210	0.310	0.421	7.000	0.120	0.110	11.848	0.981	100.000
6	80.921	1.121	0.725	5.450	0.321	----	10.252	1.210	100.000

IMPURITIES.			REMARKS.
Soda.	Calcium Sulphate	Sodium Chloride.	
faint trace			Superior quality of starch, being *four* to *five* times purer than average commercial starch.
" "			
0.179			A fair sample of commercial starch.
0.161			An average sample commercial starch.
0.171			An average commercial starch.
0.101			An average commercial starch.
0.187			A fair commercial starch.
0.202			An impure commercial starch.
0.359			Unfit for culinary use.
0.192			A poor sample of commercial starch.
0.100			A fair sample of commercial starch.
0.200			An average sample of *rice* starch.
0.277			Excess of caustic alkali.
0.160			An ordinary commercial starch.
0.171			A fair commercial sample.
0.182			A fair commercial sample.
0.192			Too impure for culinary use.
0.306			Too high in mineral matter for food.
0.223			Impure commercial sample—excess alkali.
0.263			Impure commercial sample—excess alkali.
0.321	0.228		A very impure starch, unfit for food.
0.287			Below standard of commercial purity.
0.361			A very impure starch, unfit for human food.
0.261			A very ordinary sample of starch.
0.206		0.100	Too high in mineral impurities for culinary use.
0.261			An impure commercial starch.
0.228			Too high in mineral impurities for food.
0.388			Too high in mineral impurities and alkali for food.
0.238			Imperfectly separated and impure.
0.220			A fair commercial sample with excess of alkali.
0.261			A very impure rice starch with excess of alkali.
0.224			A poor starch, strength killed by use of free alkali.
0.259			Very impure and imperfectly prepared.
0.459			Very impure and unfit for culinary purposes.
0.521		0.088	Contains an abnormal % alkali—unfit for food

Abstracts of American Patents Relating to Chemistry.

(From the U. S. Patent Office Gazette.)

(Issued October 4, 1892.)

483,522.—Fire extinguisher. Oscar J. Averell, New York, N. Y.

483,532.—Chloridizing muffle furnace. Hugh Calhan and Aaron M. Beam, Hot Springs, Ark.

483,560.—Method of affixing manufactured asbestos. Frederick W. Jaqui, Jr., Cleveland, O.

The manufactured asbestos is saturated with water or its equivalent, and while wet pressed upon the surface to be covered.

483,562. } Storage batteries. Edward R. Knowles, Burkley, N. Y.
483,563. }

43,565.—Artificial marble. Jörgen G. Maardt, Copenhagen, Denmark.

A composition consisting of burnt gypsum, potash, alum, magnesite, magnesium, chloride, burnt flint and water.

483,570.—Furnace. Lewis Metesser, New Orleans, La.

483,577. } Furnaces for treating steel. John Peddie, Pittsburg, Pa.
483,578. }

483,590.—Process of and machine for manufacturing wadding from cellulose and cotton. Carl Waibel, Newstadt-on-the-Hardt, Bavaria, Germany.

483,599.—Oil filter. Edwin S. Breed, Paterson, N. J.

483,607.—Apparatus for dyeing. Edward J. Gerber, Paterson, N. J.

483,634.—Washing powder. Elizabeth F. O'Neal, Philadelphia, Pa.

483,638.—Brick kiln. Charles A. Snow, Brick Haven, Va.

483,639.—Process of treating copper and pyrites. Jules Strap, Paris, France.

483,646.—Process of making artificial mica sheets for electrical insulation. Arthur H. S. Dyer, Schenectady, N. Y.

483,652.—Process of reducing zinc. Christopher James, Swansea, England.

483,653.—Molding mica forms for electrical insulators. Charles W. Jefferson, Schenectady, N. Y.

483,654.—Galvanic battery. Harry T. Johnson, New York.

483,663.—Machine for moulding articles from plastic compounds. Henry C. Warren, Boston, Mass.

483,701.—Apparatus for the manufacture of transparent sheets of pyroxyline. Edmund N. Todd, Newark, N. J.

483,709.—Apparatus for making gun cotton. Joseph Beck, Thomasville, N. C., and Oscar A. Neuninger, Newark, N. J.

483,716.—Composition for stereotype plates. William A. Force, Brooklyn, N. Y.

A composition of about two and a half pounds of rubber, four pounds two and a half ounces each of plumbago, white lead and litharge, and six ounces of sulphur. Zinc and baryta may also be used.

483,748.—Apparatus for making malt. William A. Peters, San Francisco, Cal.

483,752.—Method of working heat generator. Jacob T. Wainwright, Pittsburg, Pa.

483,758. } Electrical heaters. Arthur E. Appleyard, Boston, Mass.
483,759. }

483,766.—Process of extracting gold from its ores. Carl Moldenhauer, Frankfort-on-the-Main, Germany.

483,782.—Thermo-electric battery. Paul Giraud, Chantilly, France.

483,817.—Evaporating apparatus. Oscar B. Stillman, Natick, Mass.

483,819.—Hot air furnace. Robert Tate, Toronto, Canada.

483,826. } Process for lining digesters. Hermann Brungger, Cunners-
483,827. } dorf, Germany.

483,828.—Digester. Hermann Brungger, Cunnersdorf, Germany.

483,847.—Pulp drainer. Gustav L. Jaeger, New York, N. Y.

483,863.—Furnace. Henry C. Platts, London, England.

483,868.—Method of polishing rice or other grains. George B. Prochaska, New Orleans, La.

483,870.—Apparatus for the manufacture of paper pulp. Robert N. Redwayne, Newcastle-on-Tyne, England.

483,876.—Refrigerating apparatus. Henry Stoeg and James G. Lightford, Indianapolis, Ind.

483,899.—Machine for hulling rice. Edward J. Cantwell, Calcutta, India.

483,915.—Glass melting furnace. Ralph Gray, Anderson, Ind.

483,924.—Process of separating copper from cupriferous nickel ores. Thomas S. Hunt and James Douglas, New York, N. Y.

483,934.—Zinc furnace. Octavius Lamaghi, St. Louis, Mo.

483,936.—Furnace tap. Edward P. Mathewson, Pueblo, Col.

483,942.—Digester. Benjamin F. Radford, Hyde Park, Mass.

483,962.—Process of smelting complex silver ores. Christopher James, Swansea, England.

483,972.—Process of treating mixtures containing sulphides of precious metals and copper. Cabell Whitehead, Washington, D. C.

483,981.—Process of and apparatus for the manufacture of gas. John L. Janeway, Phœnixville, and Ferdinand Logan, Corner Stores, Pa.

483,985.—Metallurgical furnace. George W. Bierer, Allegheny, Pa.

(*Issued October 11, 1892.*)

484,016.—Fume arrester. Malvern W. Iles and Dennis Sheedy, Denver, Col.

484,017.—Device for catching and saving fumes from metallurgical furnaces. Malvern W. Iles, Denver, Col.

484,018.—Blast furnace top. Malvern W. Iles, Denver, Col.

484,020.—Blast furnace. Malvern W. Iles, Denver, Col.

484,021.—Process of recovering metals from copper alloys. Malvern W. Iles, Denver, Col.

484,024.—Apparatus for bottling beer. John H. Kersenbrock, Columbus, Neb.

484,025.—Beer apparatus. John H. Kersenbrock, Columbus, Neb.

484,033.—Process of extracting nickel from ores. Thomas McFarlane, Ottawa, Canada.

First washing ores rich in sulphur to expel excess of sulphur, then mixing sodium chloride with the ore, recalcining until sulphur fumes cease to be given off and chlorine fumes appear and until ferrous chloride is eliminated. The ore is then leached with hot water to dissolve out the nickel and the solution is treated successively with weak alkali, sodium sulphide and strong alkali for the respective purposes of precipitating the iron, the copper and the nickel. The oxide of nickel is finally reduced to metallic nickel.

484,078.—Apparatus for charging portable fountains with carbonated beverages. Jacob F. Witteman, Yonkers, N. Y.

484,080.—Process of dyeing. Ernst Zilbseen, Crefeld, Germany.

484,084.—Anti-friction alloy. Turner D. Bottome, Hoosick, N. Y.

484,096.—Galvanic battery. John W. Hoffman, Chicago, Ill.

484,114.—Vapor burner. Joseph R. Sapp, Cuyahoga Falls, O.

484,120.—Secondary battery. William L. Silvey, Lima, O.

484,134.—Confectioner's kettle. William Prierly, Rochdale, England.

489,161.—Melting pot. Roger S. Pease, Rose, Minn.

484,181.—Basic-lined furnace. John H. Darby, Brymbo, England.

484,182.—Method of electrical refrigeration. Mark W. Dewey, Syracuse, N. Y.

484,183.—Electrical depositing meter. Thomas A. Edison, Llewellyn Park, N. J.

484,184. } Manufacture of carbon filaments. Thomas A. Edison, Llew-
484,185. } ellyn Park, N. J.

484,249.—Wooden liquid-containing vessel. James M. Schofield, Merced, N. J.

484,269.—Reduction of complex ores. William C. Wetherill, Joplin, Mo.

484,286.—Lining for Bessemer converters. Carl W. Bildt, Worcester, Mass.

484,301.—Method of pressing and drying plants, and presses adapted therefor. Richard H. Day, Philadelphia, Pa.

484,319.—Brick machine. George Isaacs, St. Louis, Mo.

484,328. } Furnace for metallurgical purposes. John N. Lauth, St.
484,329. } Louis, Mo.

484,345.—Process of treating cork. John T. Smith, New York, N. Y.

484,354.—Hydrocarbon lighting device. Frederick A. Cody and Lyman T. Hawton, Meriden, Conn.

484,385.—Battery compound. William Wright, New York, N. Y.

A dry granular composition prepared by "subjecting sulphuric acid containing a metallic oxide and a chromium compound to a temperature of 275° Fahr. for fifteen minutes and spreading the same on a plate cooled to 60° Fahr. to become dry and granular."

(*Issued October 18, 1892.*)

484,388.—Process of making ultramarine blue. Johann Büttel, Newark, N. J.

484,416.—Apparatus for refining metals by electricity. Charles R. Fletcher, Boston, Mass.

484,452.—Apparatus for separating molten materials of different specific gravity. Orrin B. Peck, Chicago, Ill.

484,458.—Fluid pressure regulator. Charles J. Rinderknecht, Indianapolis, Ind.

484,465.—Rotary water meter. Carl Schon, Toledo, Ohio.

484,475.—Apparatus for the manufacture of carbureted hydrogen. James W. Tallmadge, Albany, N. Y.

484,476.—Process of and apparatus for forming solid metal ingots. Arthur J. Thowless, Newark, N. J.

484,521.—Yellow dye stuff. Hans Küzel, Höchst, Germany.

"A coloring matter derived from diamid-sulphone and oxycarbonic acid. An orange brown powder difficultly soluble in water; totally insoluble in chloroform, ligroin, bisulphide of carbon; soluble in solutions of alkalies, ether, ethyl and methyl alcohol, and mos treadily soluble in acetone."

884,535.—Apparatus for electro-plating. Frank H. Howard, Irvington, N. J.

484,546.—Process of treating bisulphate of soda. Eugene J. Barbier, Paris, France.

484,570.—Process of separating matter from slag. Edwin C. Pohle, Denver, Col.

484,579.—Process of making cyanides. George T. Beilby, Stateford, Scotland.

Ammonia is brought into intimate contact with a liquid, fused mixture of anhydrous alkali, cyanide and carbon.

484,595.—Brick kiln. William A. Koneman, Chicago, Ill.

484,596.—Gas producer. William A. Koneman, Chicago, Ill.

484,624.—Apparatus for the manufacture of gas. Augustus L. Allen, Poughkeepsie, N. Y.

484,631.—Nitrogenous fertilizer, and process of making the same. John J. Dunne, Philadelphia, Pa.

484,633.—Middling purifier. Joshua H. Goodall, Castleford, England.

484,659.—Slag separator. John F. Keeper, Denver, Col.

484,664.—Apparatus for pickling and washing metal plates, etc. Geo. Mesta, Pittsburg, Pa.

484,679.—Fertilizing composition. James D. Simmons, Hagarstown, Ind.

Composed of ferrous sulphide, potassium sulphate, wood ashes and calcium phosphate.

484,682.—Centrifugal milk tester. Ralph Stoddard, Rutland, Vt.

484,697.—Blue dye. Rene Bohn, Mannheim, Germany.

A product of the combination of tetraalkyldiamidobenzophenone with dihydroxynaphthaline, by an agent such as phosphorous oxychloride.

484,704.—Apparatus for the manufacture of metallic articles by electrolysis. Alexander S. Elmore, Leeds, England.

484,714.—Fireproof paint. Walter S. Hill, Boston, Mass.

Composed of zinc hydate, an alkaline salt, asbestos, white lead, linseed oil and a pigment.

484,717.—Dust collector. William Ince, Hayle, England.

484,721.—Carbureting apparatus. James J. Parris, Beaver Falls, Pa.

484,730.—Water gas generator. Reinhold Boeklin, Omaha, Neb.

(Issued October 25, 1892.)

484,770.—Converter. William A. Baldwin, New York, N. Y.

484,774.—Garbage drier and burner. Frederick Cain, St. Paul, Minn.

484,777.—Machine for shaping and moulding plastic materials. Oliver R. Chase, Boston, Mass.

484,781.—Filter. William M. Deutsch, Elizabeth, N. J.

484,784.—Steam-jacketed kettle. Stephen H. Emmens, London, England.

484,785.—Magneto-electric generator. Sydney Evershed, London, England.

484,790.—Apparatus for automatically compressing chocolate, etc. Paul Guerin, Paris, France.

484,794.—Roofing compound. Samuel Herbert, Detroit, Mich.

484,821.—Drying apparatus. Hannibal W. Rappleye, Philadelphia, Pa.

484,823.—Apparatus for purifying sewage. Ernest E. Scruby, Epping, England.

484,831.—Evaporating apparatus. Oscar B. Stillman, Natick, Mass.

484,837.—Incrustation preventer. William H. Wilson, Indianapolis, Ind.

484,851.—Paint mixer. Peter Faust, Brooklyn, N. Y.

484,861.—Apparatus for testing ores. Harrison B. Much, Chicago, Ill.

484,869.—Process of separating gold and other metals from their ores. George J. Atkins, London, England.

484,875.—Method of treating ores containing nickel. Jean de Coppet, Paris, France.

484,877.—Process of separating iron from ore. Henry H. Earnes, Baltimore County, Md.

484,884.—Grinding mill. Gustav Schock, New York, N. Y.

484,889.—Soda water apparatus. William H. Collins, Malden, Mass.

484,896.—Brick press. Joseph J. Kulage, St. Louis, Mo.

484,897.—Brick and tile machine. Joseph J. Kulage, St. Louis, Mo.

484,901.—Art of and apparatus for carbonating liquids. Carl A. Schneible, New York, and Joseph Schneible, Brooklyn, N. Y.

484,910.—Fruit evaporator. William C. Gilham, Morristown, O.

484,913.—Refrigerating apparatus. Daniel L. Holden, New York, N. Y.

484,916.—Method of separating butter from milk. Carl G. P. de Laval, Stockholm, Sweden.

484,921.—Process of making potassium carbonate. Peter Römer, Bernburg, Germany.

484,927.—Sterilizer for surgical instruments. Edward Boeckmann, St. Paul, Minn.

484,933.—Ore separator and amalgamator. Fred J. Hoyt, Chicago, Ill.

484,942.—Smelting and reducing plant. John Rourke, Denver, Col.

484,946.—Steam generator or evaporator. George W. Baird, U. S. Navy.

484,949.—Carbureter. John Clingman, Dayton, O.

484,955.—Liquid cooler. Horace C. Gardner, Chicago, Ill.

484,959.—Electro converter. Ludwig Guthman, Fort Wayne, Ind.

484,963.—Apparatus for and method of recovering waste alcohol from liquor casks. Michael Hickey, Boston, Mass.

884,968.—Apparatus for hardening strips of metal. John Logan and Milton H. Stevens, Waltham, Mass.

484,983.—Refrigerating compound. Willburt C. Trussell, Boston, Mass.

Composed of ammonium chloride, sodium bicarbonate, potassium permanganate, potassium nitrate, brine and ice.

484,990.—Electrolytic process and apparatus. Henry Blackman, New York, N. Y.

484,999. } Paper pulp digester. Charles Curtis, Newton, Mass., and
485,000. } Nathaniel M. Jones, Bangor, Me.

485,004.—Steam condenser and purifier. Rees W. Dugan, Covington, Ky.

485,009.—Apparatus for generating gas. Charles W. Isbell, New York, N. Y.

485,012.—Process of treating beer. Arnold Kreusler, Kreischerville, N. Y.

485,013.—Secondary battery. William Main, Brooklyn, N. Y.

485,024.—Faucet filter. George F. Aishton, Rochester, N. Y.

485,026.—Liquid measuring device. Walter H. Beecher, Cincinnati, O.

485,035.—Process of separating tin from tin plate waste. Hans C. W. Harrison, Lueneburg, Germany.

The tin waste is treated with a dilute mixture of sulphuric acid and nitric acid, and the solution finally transferred to a vessel containing a heated mixture of dilute nitric acid, whereby the tin is precipitated as stannic oxide.

485,050.—Apparatus for decanting bottles. Fritz Moog, Mulheim-on-the-Mosel, Germany.

485,063.—Process of producing paint pigment from ores. Noah B. Smith and Carl P. Ludwig, Birmingham, Ala.

485,069.—Grinding pan. Albert J. Taylor, Silver City, Nev.

485,075. } Air or gas meter. Fred E. Youngs, Allegheny, Pa.
485,076. }

485,089.—Standard cell for electrical batteries. Henry S. Carhart, Ann Harbor, Mich.

485,090.—Apparatus for manufacturing pulp. John B. Carter, Kokimo, Ind.

485,103.—Match-heading composition. Jacob Klein, New York, N. Y.

Consists of dextrine water, phosphorus, minium, lamp black and nitric acid.

485,113.—Soap. Julius Niese, St. Louis, Mo.

Composed of common soap, powdered calcined bone dust, equal parts; about one-twentieth part of powdered sulphur.

485,126.—Apparatus for treating liquids with gases. George Lunge, Zurich, Switzerland.

485,149.—Apparatus for manufacturing ice. James Buckner, Boston, Mass.

J. F. G.

Regular Meeting, December 2d, 1892.

The regular meeting of the Society was called to order at 8:30 p. m. in the Law Lecture Room of the University. Prof. A. A. Breneman in the chair.

Prof. Johnson of Yale College a past President of this Society was present and was invited to take the chair, but asked to be excused in the interest of expediting the business of the meeting.

There were no new members elected. The following nomination to membership were made :

Robt. Heerlein, Natrona, Pa.

Pierre S. Du Pont, Wilmington, Del.

Cyril P. Mertens, Newark, N. J. (Roseville).

Chas. Platt, Vandenbergh Laboratory, Buffalo, N. Y.

A paper on the "Albuminoids of Maize" was read by Dr. Geo. Archbold.

Discussed by Messrs. Johnson, Osborne, Geisler, Breneman, Waller.

A letter from Mr. T. D. O'Connor asking that his resignation which was before the Society should be acted on, was read. The resignation of Mr. O'Connor was accepted.

A circular letter from the American Philosophical Society of Philadelphia requesting that a delegation be sent to their 150th Anniversary to be held in Philadelphia, May 22–26, 1893, was read.

It was moved that Prof. Geo. F. Barker be asked to act as the delegate from the Society. Carried. The Corresponding Sec'y was instructed to notify Prof. Barker.

Dr. Bolton exhibited a printed card of the rules for spelling and pronunciation of chemical terms prepared by the U. S. Bureau of Education.

Prof. Hale reported that he had communicated with the members of the council in regard to a discussion of the rules of spelling and pronunciation at the Pittsburgh meeting, and had asked those who could not be present to send their views in writing. The meeting was then adjourned.

Durand Woodman,
Recording Secretary.

THE PITTSBURGH MEETING.

MINUTES OF ANNUAL MEETING held at PITTSBURGH, PA., Dec. 28th, 1892.

The meeting was called to order at 10:30 A. M., in the rooms of the Pittsburgh Academy of Arts and Sciences, by Professor A. H. Sabin, Chairman of the Committee of Arrangements.

The following papers were read:

I. "On Honey from the Aphis, or Plant Louse," by Dr. H. W. Wiley. Read by Prof. Sabin, in the absence of the author.

II. "Official Milk Analysis in Canada," by Prof. W. H. Ellis, Toronto, Canada.

III. "On the Effect of Decomposing Organic Matters on the Solubility of Natural Phosphates," by Prof. N. T. Lupton.

The paper was discussed by several members.

During the reading of papers Prof. Appleton arrived and was asked to take the chair. He was succeeded by the President, Prof. G. C. Caldwell. After the reading of papers, announcements were made in regard to excursions to be made by the Society, the first being to the Works of the Pa. Lead Co., and the Glass Works at Temperanceville.

The meeting was then adjourned to 8 P. M.

DURAND WOODMAN,
Recording Secretary.

SECOND SESSION.

Called to order at 8 P. M. Dr. C. B. Dudley in the chair.

Prof. Caldwell delivered his address as President, on "The American Chemist: His Past and Present."

The Report of the Librarian was read and accepted. It was further ordered that its recommendations be referred to the incoming Board of Directors, with power to execute them.

Prof. Sabin here stated that a contribution to the Library had been received by him from Prof. F. H. Storer on the "Life and Works of the late Prof. Warren."

Prof. Hale then reported for the Committee on Elections; first in regard to the method of election adopted in the new constitution; and second, on the vote in favor of the new constitution.

In regard to the election of officers under the new constitution, he stated that a total of 191 ballots had been received, of which only 126 were strictly regular; 29 being behind the specified time, and 36 not signed. These irregularities, however, being proportional, the results were not affected by them.

The result of the election was as follows:

President.

H. W. WILEY.

General Secretary, A. C. HALE.

Treasurer, C. F. MCKENNA.

Librarian, ELWYN WALLER.

Directors.

For two years:

WM. MCMURTRIE, A. A. BRENEMAN,
A. R. LEEDS, A. H. SABIN.

For one year:

DURAND WOODMAN, C. A. DOREMUS,
C. F. CHANDLER, P. T. AUSTEN.

Members of Council.

For three years:

J. W. MALLETT, G. C. CALDWELL,
A. B. PRESCOTT, T. H. NORTON.

A question arose as to when the terms of office of the present officers expired. It was found that the new constitution provides

that all officers shall serve from the close of the annual meeting at which they are elected until the close of the following annual meeting or until their successors shall be chosen.

A paper was then read: "On Nickeliferous Pyrrhotite," by Dr. S. H. Emmens.

The paper was followed by some discussion.

It was announced that, in the morning, visits would be made to the Howard Plate Glass Works and the Duquesne and Homestead Works, and in the afternoon to the Pittsburgh Reduction Works and the Chambers Glass Works.

Prof. Morley then spoke, by invitation, on his work in determining the atomic weight of oxygen, describing his method of weighing, the degree of accuracy obtained, the difficulties surrounding the work, etc., etc.

A letter was read from Mr. H. C. Frick, President of the Coke Co. bearing his name, inviting the members to visit the Works.

On motion the meeting was then adjourned to 8 P. M., Dec. 29.

DURAND WOODMAN,

Recording Secretary.

LAST SESSION.

DECEMBER 29th, 1892.

The meeting was called to order at 8:45 P. M. Prof. Edward Hart in the chair.

The reading of papers was taken up as the first order of business.

The following papers were read:

I. "Problems in Physical Chemistry." By Prof. R. B. Warder.

II. "On American Lithographic Stones." By Dr. C. W. Volney. Read by the Corresponding Secretary for the author.

III. "The Composition of some Modern Powders." By Prof. C. E. Munroe.

A communication from J. F. Geisler, suggesting the adoption of a standard Table of Atomic Weights, was read by Prof. A. H. Sabin.

Prof. J. H. Appleton advised the appointment of a permanent committee on atomic weights, to report each year on a table for the acceptance of the society.

Prof. Munroe moved that a committee of one be appointed by the chair to report at the next annual meeting. The motion was seconded after some discussion.

The chair appointed Prof. F. W. Clarke.

It was moved and seconded that the report of the Committee of American Association for the Advancement of Science on Spelling and Pronunciation of Chemical Terms, which has been published by the National Bureau of Education, be adopted by the American Chemical Society.

Prof. Hale said, that if the matter was open for discussion formally, he would like to say a word or two in reference to the opinions of the different members of the Council to whom the matter was referred for their opinion. While in the main, some thought well of the report of the committee which was adopted by the A. A. A. S., yet there were criticisms both in regard to major and minor details.

The Chairman: "I suppose it will not be out of place as a member of the committee, the only member of the committee present at this meeting;—if I say that in view of the difference of opinion it seems to me desirable to take no action at all in the matter. My own view in all this committee's work is that we really ought not to appoint any one else to do or ask them to do anything that they do not feel perfectly free to do. In other words, we should be a deliberative body and not decide upon many things.

"It seems to me desirable that this feature should be insisted upon in all such meetings, and I for one have felt that in the American Association we depart entirely too far from that, I think—well established principle—so that for myself, I should not like to see anything of that kind adopted which would be felt as undesirable and irksome, even by one member of the American Chemical Society."

"Prof. Prescott suggested the other day that this would be a good subject for general discussion at the Congress of Chemists

to be held next year at Chicago. He seemed opposed to adopting anything formally by vote."

It was moved that this matter be laid on the table. Seconded and carried.

A vote of thanks was moved by Prof. Appleton as follows:— The Society hereby tenders its sincere thanks to many persons and corporations to whom it is indebted for invitations to visit works and for other attentions which have contributed to make the Pittsburgh meeting a most successful one. Especial recognition should be made of the kindness of the following persons and Companies:

Messrs. Hunt and Clapp.

Mr. Handy and Mr. R. M. Streaty.

The Academy of Art and Sciences.

The Engineers' Society of Western Pennsylvania, especially the chemical section.

The officers of the Pennsylvania Lead Co., especially Mr. Faunce.

The officers of the Duquesne Steel works, and of the Homestead Works, and especially Mr. Kent.

The officers of The Wightman Glass Co., the Howard Plate Glass Co., the Chambers Glass Co., the Pittsburgh Tin Plate Works, the Pittsburgh Reduction Co., and the H. C. Frick Coke Co.

The Corresponding Secretary read a list of about thirty-five nominations to membership awaiting action of the Council.

The Sixth Annual Meeting was then adjourned.

DURAND WOODMAN,
Recording Secretary.

THE AMERICAN CHEMIST.

By Prof. G. C. Caldwell.*

I have chosen for the subject of my address as retiring president of this society, one that seems appropriate to this occasion of the first gathering of a representation of American chemists on a fully organized basis as an American Chemical Society. My topic is the "American Chemist; his Past and Present;" and if I were but a prophet I would venture to add, his future. Even as a historian I can claim neither special gifts nor training, and what I may have to say must be regarded only as a contribution to the treatment of so large a subject.

The earlier records of the work of the American chemist are to be found only in periodicals of a general scientific character; for it is only within comparatively recent years, as we know, that he has been fortunate enough to have journals devoted exclusively to his own science. Before the establishment of these chemical journals, the *American Journal of Science and Arts*, better known as *Silliman's Journal*, contained almost the entire record of his work. Besides and before this were only Transactions of scientific societies to which, however, he was but a meagre contributor, with a few notable exceptions.

The oldest of these Transactions were those of the American Philosophical Society of Philadelphia; contemporaneous therewith was the New York Medical Repository. My history begins with what I can find in these periodicals or Transactions. Believing that the whole history can be presented in a more interesting manner if I divide the period over which it extends into distinct subperiods, I will give my account of it by decades after and inclusive

* An address delivered by the retiring President of the American Chemical Society at the sixth general meeting, Pittsburg, Pa., December 28, 1892.

of the year 1800. What little there is on record of the American chemist's work prior to that year may be included in one period and set forth in a few words.

Of that time, just at the close of the last century, Dr. Priestley was the most prominent figure in chemical science. Indeed, if it had not been for his coming to this country, and his persistent devotion to the doctrine of phlogiston, and the opponents whom he aroused, there would have been exceedingly little to note of chemical work of any kind. As far back before this as 1769 a paper was read before the American Philosophical Society, and published in the first volume of the Transactions, entitled "An analysis of the chalybeate waters of Bristol in Pennsylvania," by one Dr. DeNormandie. This being, I think, the first chemical analysis made in this country, an account of it in the author's words will not be inappropriate. It runs as follows: Exp. (I.) "A small portion of white oak bark infused in the waters induced an immediate change from transparency to a dark purple color, which it retained twenty-four hours without depositing any sediment. (II.) Some of the same water after being made hot, or exposed for a few hours to the open air, in a great measure lost its irony taste, and received no other color than that of a common tincture from the white oak bark. (III.) One drop of strong oil of vitriol in two ounces of the water produced no sensible alteration; and the water after standing some time continued transparent, without depositing any okerish or other sediment to the sides. (IV.) Ol. Tart. pr. deliq. dropped in some of the same water induced a change of color, rendering it somewhat yellow, and in time precipitated to the bottom of the cup a fine gold colored oker. (V.) Sixteen ounces avoirdupois carefully evaporated to dryness in a china bowl in B. M. [*bain marie, i. e.*, sand bath] left one grain of a yellowish brown powder of the taste of tart. tartariz. (VI.) Linen moistened with the scum floating on the top of the spring is tinged with a strong iron mould. (VII.) This water in weight is exactly the same as rain water. From these experiments it is sufficiently evident that this water in its natural state contains a large portion of iron dissolved in pure water by means of an acid, which acid is extremely volatile and of the vitriolic kind."

In another paper the author goes on to describe nine other experiments of the same sort, from which he concludes that his first deduction is confirmed that the water contains considerable iron, that the acid must be either vitriolic or nitrous, that there is a small portion of neutral salts in these waters, that they contain sulphur, and that they are slightly alkaline. The author then discusses the medical properties of the water, comparing it with the German Spa.

Nothing else appears till 1793 when there is published an account of an earthy substance found near Niagara Falls, and vulgarly called "spray of the falls."

We turn from such crude work as this, even though probably the best possible at the time and place, to that of Priestley, and his opponents, with a sense that we have hold of something of far greater importance, even if the main writer was all wrong in his theory. His first paper printed in this country appeared, I think, in 1796, in the same Transactions on "Experiments and observations relating to analysis of atmospheric air:" also further experiments relating to "Generation of air from water," the conclusion from which is that water is convertible into phlogisticated air. From this year on to the end of the century, he published numerous short articles in this periodical and in the New York Medical Repository.

In December, 1799, he read a paper before the American Philosophical Society on "Change of place in different forms of air through several interposing substances" and, says Dr. Bolton, "recognizes distinctly for the first time the phenomenon of gaseous diffusion." In the volume of the New York Medical Repository for 1798–9, he published eight letters to Dr. Mitchell defending the doctrine of phlogiston. In the same journal Dr. J. Woodhouse, Professor of Chemistry in the University of Pennsylvania, had many papers, from 1795 to 1800 and beyond, opposing Dr. Priestley's phlogistic views. What meagre showing this is, when we consider that, on the other side of the ocean, we find in the *Annales de Chimie*, the first volume of which appeared in 1789, such names of French chemists as Fourcroy, Lavoisier, Berthollet, Chaptal, Sennebier, Pelletier, Seguin, Vauquelin, Guyton

de Morveau and others, as contributors, from 1789 to 1800, of articles on the greatest variety of chemical subjects; qualitative and quantitative analyses of minerals and mineral waters, studies of the chemical properties of elements and of their compounds, the chemistry of plant life and animal life, proximate analyses of some organic substances, the preparation of pure salts of various kinds, the illuminating power of different oils, besides the discussions on phlogiston, which were of course a prominent feature in the chemical literature of that period, when this theory was receiving its death blows at the hands of Lavoisier. Books on chemistry were published, such as *Methode de Nomenclature Chimique, Traité de Chimie, Essai de Statique Chimique, System des Connaissances Chimique, Philosophie Chimique;* and in that same period the *Annales de Chimie* was started. In Germany there was Richter, author of *Anfangsgründen der Stöchiometrie, der Messkunst Chemischer Elemente,* and "*Ueber die neueren Gegenstände in der Chemie,*" in which he established by his own researches "the doctrine of proportions by weight, and showed that acids combined with bases to form salts, and developed the law of neutralization." There was also Klaproth, the first Professor of Chemistry in the University of Berlin, who developed especially quantitative analysis, established by his improved methods the composition of many minerals, and discovered uranium, titanium and zirconium. In Sweden there was Scheele, who made a multitude of important contributions to chemistry, of which even a very imperfect enumeration would take too much of my time; and Bergmann, eminent as an analytical chemist and for his researches in analytical chemistry.

In England there was Cavendish who established the composition of water, and of nitric acid.

We pass on to the next decade, 1800–1809, when in England Sir Humphrey Davy first appeared prominently as a discoverer in chemistry, and published his account of the isolation of the metals potassium and sodium, and Dalton with his first developments of the atomic theory; when in Sweden there was the great Berzelius who, from 1807 on, devoted his entire energy to one great aim, the development of the atomic theory, and the first volume of

whose *Lehrbuch* appeared in 1808; in France, Gay Lussac who, in 1808, announced the law of combination of gases by volume; Thenard, beginning in 1807 his investigations on the compound ethers; and Proust (really in Madrid, whither he went from France) who, in the last year of the preceding decade, began his fight with Berthollet, contending for eight years for the constancy of proportion in the composition of chemical compounds.

Surely something of the spirit of this great work going on in Europe should begin to make itself felt across the Atlantic, even though the communication between the new world and the old was still so difficult, and narrowly limited. But there is practically nothing recorded in the only journals to which I have access, those already named, and there is good ground for believing that nothing important was done. Priestley was still contending for phlogiston with Dr. Morehouse and Dr. Mitchell, and performing some experiments of small account compared with what was being done abroad; such as "Observations on the discovery of nitre in common salt which had been previously mixed with snow," and "Transmission of acids, etc., in the form of vapor over several substances in hot tubes;" "Production of air by the freezing of water." Robert Hare, Jr., first appears in an "Account of fusion of strontites and volatilization of platinum," and B. Silliman in an "Analysis of a meteoric stone." Also, there is mention of perhaps the first soil analysis in America, under the title "On the substances which constitute the mineral soil of the environs of Boston."

All records fail me of any work done in the next decade, nothing being given in the above Transactions, till the appearance of Silliman's Journal in 1819; the eight short papers of that year, one of them by Dr. Hare, and the others by Silliman, only one to four pages each, and relating to unimportant topics, merit no further mention.

In the *twenties* over seventy papers of chemical import were given in Silliman's Journal, of which sixteen, mostly by Robert Hare, and very short with but four or five exceptions, referred to new forms of chemical apparatus or to reagents; seventeen, from one to seven pages in length, related to analyses of minerals; there

were two papers on the present state of chemical science and three on atomic weights, or points in chemical theory; other topics were generally of no special interest. In the Transactions of the American Philosophical Society, and in the Journal of the Franklin Institute which was started during this period, and the Proceedings of the Lyceum of Natural History of New York, were nine short papers, chiefly on analyses of minerals.

In the *thirties* about one hundred papers appeared in Silliman's Journal and the Journal of the Franklin Institute, nearly all of which were short—less than five pages long; but the character of the work, so far as indicated by the topics, was becoming higher; twenty-six papers related to studies of the properties of chemical elements or their inorganic compounds, and fifteen to studies in organic chemistry—none of them very deep perhaps, but still on a higher plane than heretofore; only fifteen related to analysis of minerals or mineral waters, six or eight to technical matters, and seven to analytical methods; the remainder were on miscellaneous topics, mostly of subordinate importance. About twenty-five of the whole number of papers were contributed by Dr. Robert Hare, many of them very short, and, as in previous years, on new forms of apparatus or new methods of preparation of substances, in the devising of which he appears to have been very ingenious. No other single writer was so prominent in the records of either this or the preceding decades.

In the *forties* (1848) a new periodical was added, the Transactions of the American Association for the Advancement of Science. Furthermore, original work in chemistry took a wonderful start; and well it might; for such names appeared, familiar enough to some of the oldest of us, if not to the younger men in my audience, as W. B. and R. E. Rogers, the first of whom afterwards took an important part in the organization of the Massachusetts Institute of Technology; J. Lawrence Smith, C. U. Shepard, John W. Draper, T. Sterry Hunt, E. N. Horsford and W. Gibbs, many of whom had received their inspiration in the laboratories of Germany. Smith studied under Orfila, Dumas and Liebig; Draper, a native of England, under Dr. Turner of the University of London; Horsford under Liebig; Dr. Gibbs under Rammelsberg, Rose, Liebig and Regnault.

Over a hundred papers appeared in the periodicals above named, and, while greater length does not necessarily mean much, nevertheless when papers of ten, fifteen, twenty pages or over, are the rule, rather than papers of two to four or five pages, it is not far out of the way to suppose that when such men as these I have named, and Silliman and Hare, write them, they are not made up of padding. Classifying these hundred or more papers roughly, about forty-three of them may properly be called purely scientific papers on inorganic chemistry, twenty on organic chemistry, twenty on analyses of minerals and waters, ten on analytical chemistry, and the rest on technical or other topics more removed from pure science. J. Lawrence Smith contributed eight of these papers; Hunt, ten; the Rogers brothers, eight. Dr. Hare was still prolific, contributing eight papers. Eight of the papers were purely theoretical; such as those on "The idea of an atom suggested by the phenomena of weight and temperature;" "Allotropism of chlorine as connected with the theory of substitution;" "Anomalies presented in the atomic volumes of phosphorous and nitrogen;" "Principles to be considered in chemical classification;" "Theory of compound salt radicals."

In the *fifties* about one hundred and seventy papers were published, against one hundred in the preceding decade, classified as follows: purely scientific, inorganic chemical work, about sixty; organic, eight; analytical, twenty-three; mineral analyses and studies, forty; technical subjects, nineteen; miscellaneous, eighteen. Several of these papers are theoretical studies; as, "Comparison between atomic weights and chemical and physical action of barium, strontium, calcium and magnesium, with some of their compounds;" "Numerical relations between the atomic weights, and some thoughts on the classification of the elements;" "Theoretical relation of water and hydrogen;" "Apparent perturbation of the law of definite proportions in compounds of zinc and of antimony;" "Rational constitution of certain organic compounds," etc. New and well-known names appearing prominently were those of Genth, Mallet, Cooke (J. P.), Brush and C. M. Warren. Robert Hare's name disappears. Cooke in his article, above mentioned, on the numerical relations between the

atomic weights, etc., classifies the elements in six series similar to the series of homologues in organic chemistry ; in each series the difference between the successive atomic weights is a multiple of some whole number, this number being different for the different series. He shows that the properties of the elements in each series follow a law of progression ; the numerical law for the progression in the specific gravity is given ; and when a sufficient number of determinations shall have been made of such other properties as are capable of measurement, he predicts that numerical laws for each of these kinds of variation can be ascertained. Thus he looks forward to a perfect science of chemistry in which we shall be able to foretell with certainty the properties, not only of undiscovered elements in any given series, but also of the compounds of these elements. There are many correspondences between his classification and that of Mendlejéef, and as above shown, he foreshadows the idea, already realized with the aid of Mendeljéef's classification, of the possibility of locating and describing hitherto unknown elements. Hunt contributed seventeen of the papers, largely given to the analysis and constitution of minerals; indeed the examination of American minerals was a very prominent feature of the chemical work of this decade, as shown by the number of papers on the subject. J. Lawrence Smith and Mallet did the largest part of their work on this line, and the former made an important contribution to the methods of analysis of minerals, in his new process for the separation of the alkalies. It was in this decade, that the famous work appeared of Gibbs and Genth on the Ammoniao-Cobalt Bases, covering 59 quarto pages of the Smithsonian Contributions to Knowledge—the longest single article that had up to that time appeared on a chemical research. A redetermination of the atomic weight of lithium and of antimony was made by Mallet, the first work of this kind done by an American chemist. It may well be said that this is the first decade of chemical research in this country which has some prominent and important characteristics to distinguish it from the others that preceded it.

In the *sixties*, about two hundred and fifteen papers were pub-

lished, against one hundred and seventy in the fifties, of which ninety pertained to general inorganic chemistry; forty to organic chemistry, twenty-eight to methods of analysis and new forms of apparatus for analytical purposes; thirty to the analysis of minerals and mineral waters; seven were on technical subjects; fourteen on meteorites, four on agricultural chemical topics, and three on animal or vegetable physiological chemistry. More attention was given in this decade than in the preceding one to more purely scientific studies in general chemistry, for on inorganic and organic chemistry together there were one hundred and thirty papers, against only sixty-eight in the earlier period, while analyses of new minerals, also genuine scientific work, were almost as numerous as before. The most prominent contributor was Lea, nearly all of whose papers, over thirty in number, were on important topics in both inorganic and organic chemistry. Cooke and Horsford, of Harvard, and Gibbs and J. Lawrence Smith contributed important papers, as did also Hunt; Warren made some important contributions in organic chemistry. Other contributors were, Brush, Ordway, Crafts and Wetherill. Hinrichs first appeared with his theoretical essays, which some of us have perhaps attempted to master and assimilate. Of the papers on general inorganic and organic chemistry, about forty were from ten to thirty pages in length, indicating at least as to quantity of material to be communicated, research studies of considerable length. The proportion of such long papers was very much smaller in the preceding decades.

There is much work deserving special mention in this decade, such as Clark's "Constants of Nature," a collection of all the reliable determinations of specific gravities, boiling points, melting points, specific heats and expansion by heat, and covering 450 quarto pages of the Smithsonian Miscellaneous Collections; Warren's Monograph, of 100 quarto pages in The Transactions of the American Academy of Arts and Sciences, on "A new form of apparatus for fractional condensation of volatile liquids free from objections incident to the methods in use"; and "Researches on volatile hydrocarbons"; also, his papers on "A new method for combustion in a current of oxygen gas alone,

without the use of cupric oxide"; and on "The analysis of organic substances containing sulphur and chlorine."

As one result of his work on the hydrocarbons, Warren showed that the elevation of the boiling point for an increment of CH_2 in homologous series is 30°, or much larger than was hitherto supposed; and that in certain other series derived from the benzole series, differences in boiling points for CH_2 added or removed are much smaller than 19°, Kopp's figure.

Worthy of mention is Lea's attempt at a classification of the elements in several groups, the members of each group differing by 44-45, showing that "the elements thus grouped consist of bodies whose properties are analogous,—and that this classification is in harmony with the distinguishing characteristics of the substances classified." One such group starts with Sb, 120.3; As, 75; P, 31; N, 14; Sn, 59 and Pb, 103.5. Another comprises Hg, 200; Cd, 112; Zn, 65.5 and Mg, 24.4; all the members of this last group are in one of Mendeljéef's groups, and the first four members of the first group are also in another of Mendeljéef's. This grouping is founded on a broader basis; but Lea's was published thirty years ago, in 1860.

Gibbs showed by reference to the volumetric relation of gaseous compounds that if the proposed new atomic weights, 16, 12 and 32 be accepted for oxygen, carbon and sulphur, the atomic weights of least fifty other elements must be doubled; and as he is not a man to fail to give due credit to others, it is fair to infer that he was the first to call attention to this necessity. Lea's work on the ethyl bases as he calls them, diethylamine, triethylamine, etc., is comprised in several papers, in which he gives a very full account of their reactions, and a new method of separating them by picric acid. Ordway gave a very exhaustive paper on soluble glass, its chemistry and applications; Gibbs and Lea also made extensive researches on the platinum metals; and very notable are the many contributions made by Gibbs on improvements in methods of analysis; everything coming from his laboratory was reliable, and there was much of it. Hunt published three papers on the chemistry of mineral waters, in which, on the basis of certain general principles laid down, and of a number of analyses of waters

of the Champlain and St. Lawrence basins, he attempted to trace the history of these waters and account for their origin; and in another paper he attempted also to trace out the origin of the dolomites. Crafts, with Friedel, by results of research on the silicic ethers, proved as he thinks convincingly, the tetratomic character of silicium. Gaffield's interesting researches on the action of sunlight on glass were made in this decade. Gibbs made a very valuable contribution to the resources of physical chemistry, by a calculation of the wave lengths of the lines of a large number of the elements, from measurements made by Angström and Ditscheiner, and Huggin's scale of wave lengths of 1,000 lines. Goessman discussed in a careful and thorough manner the origin of the salt beds and the composition of the salt and the brine of the ocean water.

Three notable books appeared in this decade, Cooke's *Chemical Physics*, Storer's *Dictionary of Solubilities* and Wormley's *Microchemistry of Poisons*.

In the *seventies*, about two hundred and forty papers were published, a part of them in three new periodicals. The American Institute of Mining Engineers issued its first volume of Transactions in 1871. Methods of chemical analysis naturally occupied much of the attention of the chemical members of this Institute. The American Chemical Journal, and the Journal of the American Chemical Society made their first appearance in 1879. This Society was established in 1877, and published two volumes of Transactions, prior to the issue of the first volume of its Journal. Dr. Chandler's "American Chemist" also appeared in this decade.*

Eighty of the papers published referred to general inorganic chemistry; forty-seven to organic chemistry; fifty-seven to analytical methods and apparatus; only thirteen to minerals and mineral waters, and the same to technical subjects; twenty-one short papers were on meteorites; agricultural chemistry had fourteen papers, physiological chemistry five, and sanitary chemistry two. Analytical chemistry was very much more prominent in the work of this decade, and in fact than at any time before it; methods of agricultural chemical analysis, as well as of analysis pertaining to the mining engineering interests, especially of iron and steel, re-

*This Journal was begun in July, 1870, and completed seven volumes, ending in 1876. It had been preceded by an American reprint of the English Chemical News with an American Supplement.

ceived special attention. The prominent contributors were M. C. Lea, J. Lawrence Smith, Gibbs, Remsen and Clarke; there were one hundred and thirty writers in all, of whom only fourteen contributed five or more papers, and only two, Lea and J. Lawrence Smith, contributed over ten papers; but many of these papers were short. In mass and importance of material published Gibbs, Clarke, Mallet and Remsen ranked as high as the more frequent contributors, especially if they receive the credit due them for work done in their laboratories, although published in the names of their assistants or students. The beginning of Chittenden's extended work in physiological chemistry appeared in this decade. Remsen, C. L. Jackson and A. Michael also became prominent as leaders in research in organic chemistry. Gooch, besides giving us his crucible for filtration, published a valuable work on the determination of phosphorus pentoxide. Gibbs began his long and difficult research on complex inorganic acids, of tungsten and molybdenum. Clarke traced out some new relations between the atomic volumes of the elements. Hilgard began his work on the methods of analysis of soils, in which he is now the universally recognized authority. J. W. Draper showed that the diagram given in so many works at that time, and occasionally even now, exhibiting unequal distribution of heat and actinism in the solar spectrum are misleading—that on the contrary the heat and chemical power are as great at one end of the spectrum as at the other, the diffraction spectrum showing no such inequality as the diagram represents. Lea continued his research on the action of light on silver salts and also made new determinations of the atomic weights of nickel and cobalt. J. Lawrence Smith established the presence of a solid hydrocarbon and free sulphur in meteorites. Cooke made new determinations of the atomic weight of antimony.

While there are single researches in the preceding decade of higher importance than any that appear in this, a careful comparison of the whole amount of work done might show that there was little difference in the real advance made in the two decades.

In the *eighties* we see an enormous advance in chemical work. One new chemical periodical appeared, the Journal of Analytical Chemistry.

Exclusive of papers on the examination of foods and drugs in the Reports of Boards of Health of three or four States, and of papers in Reports of Agricultural Experiment Stations, the whole number published was about eight hundred and seventy-five, and inclusive of papers excepted as above, the total would certainly not be less than nine hundred, or more than three and a half times as many as in the preceding decade. About one hundred and thirty of these papers related to general inorganic chemistry; two hundred and fifty-five to general organic chemistry; two hundred and eighty-three to analytical chemistry; over fifty to agricultural chemistry, twenty-five to technical chemistry; thirty to physiological chemistry; thirty-three to analyses of minerals and mineral waters, and also thirty-three, mostly very short papers, to analyses of meteorites. The amount of solid work on these several lines may be indicated in a measure by the length of the papers; a paper of one, two or even three pages, would as a general thing represent investigations of minor importance, and comparatively little actual work, although there may be some exceptions to the rule. Comparing in this respect the three leading lines of work, general inorganic chemistry, organic chemistry and analytical chemistry, about sixty per cent. of the papers in analytical chemistry are more than three pages long, while only twenty-two per cent. of the papers in inorganic chemistry, and nineteen per cent. of these in organic chemistry exceed that limit.

About three hundred and eighty chemists contributed these papers, of whom, however, two hundred and fifty-eight appeared but once or twice in the whole decade. The most frequent contributors were Clarke, Chittenden, Gibbs, H. B. Hill, Jackson, Morse, Michael, Mabery, Mallet, Remsen, E. F. Smith and Wiley; several valuable contributions were made by others, who published fewer papers, and in some cases very important ones.

The most notable feature in the work of this decade is the great amount of work in organic chemistry, done especially under the lead of Remsen, Jackson and Michael, most of which seemed to find its natural way to the public through Remsen's own journal. In these times when the Berichte, Liebig's Annalen, Journal für Praktische Chemie, Monatshafte and the Journal of the English

Chemical Society are giving us every year their fifteen hundred pages and more of papers on research in organic chemistry, there are at least some of us who are not only not conversant with this work, our lines of study being in other directions, but are each year getting more and more hopelessly out of touch with it. As one of those, I would not presume to pass judgment on the value of the researches in organic chemistry that are now being made in this country; but we can be confident that it is not such work as an American need be ashamed of; and I am sure we all rejoice that through these investigators our own country is contributing a large share of worthy research in this great branch of ical science.

In inorganic chemistry, Dr. Gibbs continued his work into this decade on the complex organic acids. Morley contributed his masterly papers on the analysis of air and his work on the atomic weight of oxygen; Becker, his digest of investigations on determinations of atomic weights since 1814, occupying 270 pages of the Smithsonian Miscellaneous Contributions to Knowledge; Clarke gave his recalculations of the atomic weights; M. C. Lea, his discovery of the allotropic forms of silver; Cooke and Richards, the redetermination of the atomic weights of oxygen and hydrogen; Mallet, his revision of the atomic weight of aluminum and determination of the molecular weight of hydrofluoric acid; Craft's, his determination of the vapor density of iodine, with results differing from those of both Deville and Troost, and Victor Meyer, and his paper on the vapor density of permanent gases; and Warder, some of the first beginnings of work on physical chemistry.

I have had pointed out to me by a competent authority as the most significant papers in organic chemistry, "Oxidation of substitution products of the aromatic hydrocarbons," and "Investigations on the sulphinides," by Remsen and his pupils; "Researches on the substituted benzyl compounds," by Jackson and his pupils; "Furfurol and its derivatives," by H. B. Hill, and "Researches on alloisomerism," by Michael and his pupils. Other leaders in this organic work were Mabery, L. M. Norton and W. A. Noyes.

In analytical chemistry nothing more prominent appeared than Mallet's most valuable and exhaustive work, in the Report of the lamentably short lived U. S. Board of Health, on "The determination of the organic matter in potable water" and Morley's on "The analysis of air." Analytical chemistry was much advanced along certain technical lines by the work of the Association of the Official Agricultural Chemists, begun in 1884, and by co-operative work on the analysis of iron and steel, published in the Transactions of the Institute of Mining Engineers.

In physiological chemistry, Chittenden continued with Ely and others the important work begun in the preceding decade, and published valuable papers on the digestive liquids and the products of their action on the proteids. In sanitary chemistry the work begun by the lamented Nichols in the seventies was carried further in this decade by Mallet in the paper on the determination of organic matter in potable water, already referred to, and the valuable papers by Leeds on potable water supplies, in Reports of the N. J. State Board of Health and the Journal of this Society. A large amount of work on the examination of foods and drugs was done under the supervision of the Boards of Health of a very few States, notably Massachusetts and New York, and of certain cities.

In agricultural chemistry, under the generous provision made by the U. S. Government by an Act passed in 1886, giving $15,000 annually to every State in which an Agricultural College was established under the Act of 1862, and the no less generous provision made by some of the States themselves, a very large amount of work has been done. So close are the relations of chemistry to agriculture, that the opening and liberal equipment of a chemical laboratory for special work was among the first steps taken, on the establishment of each agricultural experiment station under this grant; thus at present a chemist, with often one or more assistants, is exclusively engaged in each State in agricultural chemical investigation. Under the liberal appropriation made also by the Department of Agriculture for chemical investigation, more liberal than by any other Government, a large amount of valuable work has been done at Washington. In the outcome

of these various provisions may be included Atwater's papers on the sources of the nitrogenous food of the plant, Richardson's on the composition of American cereal grains, the work of Jordan, Armsby and their associates on the digestibility and feeding value of fodder materials, and Hilgard's continuation of his work on soil analysis. Many papers were published on improvements in methods of agricultural chemical analysis, and a very large amount of routine work was done in the examination of commercial fertilizers for the purpose of protecting the consumers from fraud. In all this a prominent part was taken also in this decade by Johnson, Goessman, Jenkins, Babcock, Osborne and others.

Thus my history closes: a hurried one, and therefore imperfect, but nevertheless giving, I trust, something of an idea of what we have come to in this country, from very small beginnings. From about eighty papers in the twenties, the first decade in which any work of importance was done, to over nine hundred in the eighties is great progress: and the progress justly appears greater, when the character of the work is also taken into account. In the twenties the papers were mostly about the analysis of minerals, or new forms of apparatus or new reagents—and mostly very short papers—and in general much below the grade of work that was going on in Europe: in the eighties the work was on the same lines and of the same order as that done elsewhere, and, as well as that, rich in important results.

But there is room for further progress still, much of it, before we in this country shall accomplish as much as our brother chemists do in Europe; before our Chemical Society shall, if it publishes a journal, be able to send out annually such a volume as the Berlin Society does, to say nothing of what appears in other German periodicals.

What are our prospects, and what our means for doing this? This kind of work is done at the universities of Germany and her technical schools. We have universities; more of them, so-called, than Germany has; we have a few technical schools of a high order, and innumerable colleges. These universities and technical schools have their chemical laboratories, as have also many of the colleges. Every State has its agricultural experiment station,

with a working chemical laboratory. So far then, as concerns laboratories, and men in charge of them more or less specially educated as chemists, there is abundant provision. Every one of these universities, colleges and advanced technical schools has a double mission to perform, if it does the whole work that is expected elsewhere in the world, of institutions giving higher instruction. One of these missions is to teach—to impart knowledge that is already a part of the world's possession of knowledge, to the students who are seeking it, now in larger numbers than ever before. The other mission is to gain new knowledge—to add to the world's stock of it. Here and there is seen a man of wealth, and scientific tastes and acquirements, and an aptitude for research, who investigates in his own private laboratory, and does good work there; but such a combination is rare. These higher institutions of learning are to be in the future, as they have been in the past, the fittest places, and indeed almost the only places, for the making of both investigators and investigations.

Why is it, with so many of these institutions as we have, making claim to this high rank in our system of instruction, that we fall so far short of contributing our full share of the world's acquisition of new knowledge, year by year? The first and perhaps most important reason is that those upon whom this work devolves, and who would be glad to do it, have no time for it. Their work of instruction, often comprising many branches of science, uses up all their energy. This unfortunate condition of affairs is chargeable, to a large extent, to the multiplicity of colleges with endowments inadequate for the performance of the whole work of a college. It may be fairly said that no institution of learning is fully worthy of being called a university, or a college of high rank, that does not provide teachers enough, so that each one has spare time for investigation. There is room for improvement in this respect, even in some of our largest universities. It is not always practicable for an outsider, such as the average trustee is, to get so thorough an acquaintance with the inner workings of the several departments, as to understand how most of a teacher's time may be consumed in the management of the petty details of a laboratory full of students, provided that he does his duty there.

Secondly, given the time when this important feature of college and university comes to be properly appreciated, will there be means for the work. There can be little doubt that they will then be provided; if not in any other way, when it appears that there are men ready and competent to carry on valuable investigations, but who cannot for want of means and appliances, new funds for the promotion of such work may perhaps be added to those already in existence—such funds as the Elizabeth Thompson Science Fund, now amounting to $26,000, the Bache Research Fund, and the Wolcott Gibbs Fund for chemical research.

Given time and means, have we the men in this country for creditable scientific research? I think that such an answer to this question as is indicated by the records of the chemical research in the decade from 1880 to 1890 is most encouraging. Great investigators like great poets, like men great in anything, are born not made; born, may we not truly say, out of the spirit of the country and the period in which their great works are done. But, when born they must be nurtured, and the place for their nurture is the university. In this sense the university must make the investigator as well as the investigation. In the land where the spirit of investigation is rife there will be the most material out of which to make investigators; and there too will men and women destined to be such be most sure to drift into the line of life work for which they are best adapted and receive the best training for it.

It seems to me that the relations of our Society to this matter of the furtherance of chemical investigation in this country are of vital importance; that if it does not appear in its stated meetings or the meetings of its sections scattered throughout the country, that it is alive with the spirit of research, it will fail to establish its reason for being; that membership of it will be of little advantage to anybody, and that the Society itself will be of little service to the country.

If I may be allowed a personal allusion I would say that it seems to me that in assuming membership of this Society I have also assumed a new duty: a duty to put forth special effort for the accomplishment of my share towards placing it on a par with other similar societies in its contributions to new scientific and technical

knowledge. If a spirit somewhat akin to this prevails amongst its members, both old and new, then shall we fully and honorably establish its reason for being.

It seems to me, further, that the evidence thereof will be looked for in the Journal of the Society; as we see in the Berichte the magnificent evidence for the reason for the existence of the Berlin Society; or, in the Journal of the English Chemical Society the evidence for the reason for the existence of that Society.

If most or even many of us feel no sense of a duty incumbent upon us to do earnestly whatever is in our power to advance the interests of this Society in the direction that I have indicated, and also to put into its journal a fair share of our testimony to this earnest endeavor, then I believe that our Society will lead a comparatively worthless life. It is my sincere hope that we may escape such a lamentable failure of our new efforts to establish an American Chemical Society worthy of its name.

HONEY FROM THE APHIS OR PLANT LOUSE.

By Dr. H. W. Wiley.

Contributions from the Chemical Laboratory of the U. S. Department of Agriculture. No. 1.

Since the publication of my article on honey dew in the American Chemical Journal, Vol. 13, pages 24 *et seq.*, I have had opportunity to examine several samples of honey collected by the bees from so called honey dew. Entomologists are not yet quite agreed in regard to the nature of honey dew, but most of them take the position that it is an exudation of the plant louse rather than an exudation from foliage which has been attacked by the plant louse. In other words the honey gathered from the plant louse has been twice digested, once in passing through the organism of the aphis, and once in passing through the organism of the bee.

In the examination of the pure honey dew collected from the trees, which is mentioned above, it was found that it contained a right-handed body having approximately a specific rotatory power of 105°, the rotation of arabinose. A sample of honey which was collected at the same time from the neighborhood, however, indicated that it was normal honey, showing that the bees did not store at least this sample of honey from the exudation above mentioned.

I had sent to me during the past summer a sample of honey with a statement that it was made by the bees gathering the honey from the plant louse. It had a right-handed polarization at a temperature of 30° of 23.10 divisions of the cane sugar scale and contained by inversion 5.21 per cent. of sucrose. In the dry substance it contained 71.58 per cent. of invert sugar, and the sum of the invert sugar and the sucrose, in the dry substance, was 77.62 per cent. It contained .62 per cent. of ash, making a total of 78.24 per cent. of solid matter by the determination of the invert sugar, the sucrose and the ash leaving 21.76 per cent. of solid matter presumably of the nature of the substance described in my first

paper. This sample of honey was polarized at 88°, at which temperature the invert sugar became optically neutral. Any excess of polarization, therefore, at that temperature must be due to the sucrose and other right-handed bodies present in excess or the dextrose and levulose or the invert sugar. The polarization at 88° of the sample under consideration was 40.30 divisions of the cane sugar scale. Deduct from this the polarization due to sucrose, namely, 5.21, and we have 35.09 divisions due to the rotation of the right-handed bodies in excess. This rotation must have been produced by the solid matter unaccounted for in the above analysis, namely, 21.76 per cent. Did this solid matter have the same specific rotatory power of cane sugar it would have polarized 21.76 divisions. If, on the other hand, it had the specific rotatory power mentioned above for the right-handed bodies, namely, 105, its polarization would be 34.9 divisions of the cane sugar scale which approximates very nearly to the actually observed polarization, namely, 35.09. Therefore it is certain that the right-handed body present in this sample is also one of the carbohydrates with a specific rotatory power of approximately 105, which confirms in every particular the results of the first investigation.

Unfortunately, the quantity of the sample which was sent me was only sufficient for the determinations mentioned, and therefore I did not have enough of the material to determine actually whether the substance present was arabinose or some other body or mixture of bodies with approximately the same specific rotatory power. I am promised, however, for next summer an abundant supply from the same source and I hope to be able to determine definitely the nature of this right-handed body.

Other samples of plant louse honey were also received by me and showed quite uniformly a slight right-handed rotation at ordinary temperatures, and also a marked deficiency of reducing sugar calculated as invert sugar. In every instance, also, so far observed, the percentage of ash in these plant louse honeys has been far above the average of the percentage of ash in pure floral honeys. The percentage of ash in six samples of honey, which were said to be of plant louse origin, are as follows seriatim : .62, .59, .79, .46, .78, .44.

It is true that in some samples of pure floral honey the percentage of ash approximates the percentage given, but in general it is very much less.

The three phenomena taken together, namely, right-handed polarization at ordinary temperatures, great deficiency in invert sugar, and high ash content appear to be, from the investigations so far made, analytical points by means of which a plant louse honey can be differentiated from a pure floral honey. It is understood, however, that the statement above made rests upon the analysis of six or eight samples of honey which, according to the reports received with the samples, were gathered largely from the exudations of the plant louse. An examination of a larger number of samples may show this dictum in regard to ash is not a reliable one, but the dicta respecting invert sugar and polarization are certainly correct. In other words, it appears possible, at the present time, to discriminate between a honey gathered by bees from exudations of plant lice and a pure floral honey extracted from the flowers themselves by the bees.

THE EFFECT OF DECOMPOSING ORGANIC MATTER ON NATURAL PHOSPHATES.

By Dr. N. T. Lupton.

During the past few years especial attention has been called to the fertilizing value of natural or raw phosphates, when applied alone in the form of floats and when mixed with organic matter, such as cotton seed and cotton seed meal.

If floats can be shown to produce as good results as acidulated phosphates, which is claimed by some, the cost of commercial fertilizers ought to be greatly reduced and the extensive deposits of soft, aluminous phosphates found in Florida and elsewhere find a ready sale. While the results of experiments are somewhat conflicting, there appear to be conditions under which floats, or ground raw phosphates, do produce as good, if not better results, than acid phosphates. The presence of decomposing organic matter is generally regarded as one of these conditions, but chemists are not agreed as to the precise nature of its action.

Liebig, in his letters on "Modern Agriculture," published in 1859, advances the theory that organic matter undergoing decay accumulates carbonic acid in the soil, and when rain falls it dissolves the carbonic acid and thereby acquires the power of taking up phosphate of lime. This carbonic acid water does not withdraw from the soil the phosphate of lime contained in it, but wherever it meets with the granules of apatite or phosphorite, it dissolves a certain portion. Under these circumstances, a solution of phosphate of lime must consequently be formed, which spreads in all directions around each granule. Wherever this solution comes in contact with soil not already saturated with phosphate of lime, the soil will take up and retain a certain portion of this salt. The portion of soil now saturated with phosphate will oppose no further obstacle to the wider diffusion of the solution.

Voelcker (Bied. Centr. 1880—866, 867) as quoted in the Journal of the English Chemical Society, Vol. 24, Second Series, page 640, draws the following conclusions:

1. Phosphates are not readily taken up by plants in a soluble form, but must be returned to an insoluble condition before they yield their useful properties.

2. The efficacy of insoluble calcium phosphate corresponds with the minuteness of division in which it is found in a fertilizer.

3. The finer the particles in a phosphatic material, the more energetic its action as a manure.

Fleischer and Kissling (Bied. Centr. 1883—155, 161) on the application of insoluble phosphates to soils, found that the action of moorland soils when mixed with insoluble phosphates is to render a portion of the phosphate soluble in water, amounting to 5.5 per cent., in one case, of the total phosphoric acid; a portion at the same time was reduced to the di-calcium salt, and in one compost heap as much as 17 per cent. of the total acid was brought into this form.

The general outcome of their experiments is that it is more advantageous to apply insoluble phosphate than superphosphate on humous soils, as they are capable of bringing insoluble phosphate into a soluble condition. This applies, however, only to peaty soils, as the presence of lime hinders this action.

In Volume 30 of the Journal of the Chemical Society, page 774, is an abstract of an article from the Journal of the Royal Agricultural Society, 1884, by Dyer, which states that the first experiments made in 1882 in a stiff clay soil containing no calcium carbonate, ground and unground coprolites were used. The comparison was made with swedes both with and without manure; in each case, the better result was from the undissolved phosphate. On the same plots, the following year, oats were grown without further addition of manure, and the produce was again, on an average, better where the undissolved phosphate had been employed. The following year 225 bushels of lime per acre were plowed in before sowing. The same quantities of manure were applied as before. The season was dry and the crop small, but in this case the produce was better where the dissolved phosphate

had been used. The ground coprolite contained more than twice as much phosphoric acid as the superphosphate.

Coming nearer home, we find that experiments made at the Alabama Agricultural Station are of similar import.

In Bulletin No. 22, new series, January, 1891, we find the following statement: "In several experiments previously conducted to ascertain the comparative agricultural value of the phosphate rock ground to impalpable powder, known as floats, with that of acidulated phosphate, the results have indicated that used in conjunction with cotton seed meal, floats are more profitable than the acid phosphate, taking into consideration the fact that floats contain nearly twice the percentage of phosphoric acid.

The soil used in these experiments was sandy drift that had been lying out many years. No commercial fertilizer had been previously applied to it."

To test more thoroughly the comparative productiveness of ground raw phosphate and acid phosphate under different conditions and to determine whether decomposing organic matter converts insoluble into soluble phosphate, two sets of experiments were carried out, one on the farm and the other in the chemical laboratory, the results of which will now be given.

The materials used were carefully analyzed by Dr. Anderson, assistant chemist, with the following results:

The acid phosphate used, gave

Water soluble phosphoric acid (P_2O_5)	9.10	per cent.
Citrate soluble " "	2.94	"
Acid soluble " "	2.32	"
Total phosphoric acid (P_2O_5)	14.36	"

The Florida phosphate reduced to a fine powder, similar to floats, gave

Moisture	4.18
Insoluble matter	32.39
Total phosphoric acid (*acid soluble*)	16.54
Iron and aluminium oxides	8.89

None of the lime phosphate was soluble in water and only 0.32

was soluble in ammonium citrate. The analysis shows an inferior grade of raw phosphate. The material purchased as "South Carolina floats" contained 2.26 per cent. of available phosphoric acid in the form of citrate soluble acid and a total phosphoric acid of 28.73 per cent. The available phosphoric acid in each of the materials used in the experiments may be stated as follows:

1. Cotton seed meal, available acid (P_2O_5) 3.19 per cent.
2. Cotton seed, " " 1.03 "
3. Florida raw phosphate, " " 0.32 "
4. South Carolina floats, " " 2.26 "
5. Acid phosphate, " " 12.04 "

Two qualities of land were selected at the station for the field experiments, one a strong red soil, the other a poor sandy soil. The results obtained were as follows; on the poor soil the fertilizers were sown broadcast:

		Lbs. Seed Cotton per acre.
No. 1	400 lbs. pulverized Florida phosphate	290.5
" 2	800 " " "	219.8
" 3	400 " acid phosphate	196.7
" 4	800 " "	144.2
" 5	No fertilizer	106.4
" 6	400 lbs. Florida phosphate with 400 lbs. cotton seed meal	249.2
" 7	800 lbs. Florida phosphate with 800 lbs. cotton seed meal	322.7
" 8	400 lbs. acid phosphate with 400 lbs. cotton seed meal	252.0
" 9	800 lbs. acid phosphate with 800 lbs. cotton seed meal	320.6
" 10	No fertilizer	233.8

Each plot was one-seventh of an acre and the usual precautions were taken to remove disturbing elements and have the conditions of cultivation and growth as uniform as possible. The details of

the work were under the immediate supervision of Mr. Clayton, assistant agriculturist. On the strong red soil, the fertilizers were applied in the drill with results as follows:

		Lbs. Seed Cotton per acre.
No. 1	200 lbs. Florida phosphate with 200 lbs. cotton seed meal	1016.6
" 2	400 lbs. Florida phosphate with 400 lbs. cotton seed meal	1105.6
" 3	200 lbs. acid phosphate with 200 lbs. cotton seed meal	844.8
" 4	400 lbs. acid phosphate with 400 lbs. cotton seed meal	1108.8
" 5	No fertilizer	863.2
" 6	200 lbs. Florida phosphate with 400 lbs. cotton seed	919.2
" 7	400 lbs. Florida phosphate with 800 lbs. cotton seed	1182.4
" 8	200 lbs. acid phosphate with 400 lbs. cotton seed	1178.4
" 9	400 lbs. acid phosphate with 800 lbs. cotton seed	1387.2
" 10	No fertilizer	931.2
" 11	400 lbs. Florida phosphate	892.8
" 12	400 " acid phosphate	975.2
" 13	400 " cotton seed meal	1271.2
" 14	800 " cotton seed	1294.4

The land was not uniform in natural productiveness but improved in quality from the first to the last plot. While the results are not perfectly uniform the pulverized raw phosphate evidently produced as good if not better results than the acid phosphate, whether used alone or mixed with cotton seed and cotton seed meal.

Anticipating these results, experiments were carried on in the

laboratory during the summer to determine whether they are due to the fact that decomposing organic matter converts insoluble or acid soluble lime phosphate into the available or citrate soluble condition. For this purpose, half-gallon, wide-mouthed glass jars were used and the following mixtures placed in each :

No. 1....2 lbs. Florida phosphate with ½ lb. cotton seed meal.
" 2....1 " " " " "
" 3....2 " South Carolina floats " "
" 4....1 " " " " "
" 5....2 " Florida phosphate with ½ lb. cotton seed.
" 6....1 " " " " "
" 7....2 " South Carolina floats " "
" 8....1 " " " " "

The contents of each jar were rubbed up in a porcelain mortar moistened with water, and mixed as thoroughly as possible. The mixtures were stirred frequently, in fact nearly every day. Fermentation began within a day or two and continued during the whole period of the experiments. Samples for analysis, that is, for the determination of available phosphoric acid, were taken from the jars and analyzed with results as follows:

Date of taking Sample.	*Per cent. of available P_2O_5 found.*							
	1	2	3	4	5	6	7	8
July 2..	0.99	1.69	2.68	3.04	0.58	0.54	2.77	——
" 9..	1.25	1.62	2.89	2.64	0.72	0.95	2.33	2.27
" 16..	1.25	1.61	2.89	2.82	0.72	0.80	2.29	2.26
" 23..	1.16	1.80	3.37	3.22	0.84	0.49	2.37	2.39
" 30..	1.12	1.60	3.02	3.38	0.72	0.53	1.81	2.70
Aug. 6..	1.41	1.79	2.87	3.15	0.82	1.08	2.49	2.57
" 20..	1.41	1.57	2.73	3.26	0.81	1.00	2.15	2.53
Sept. 3..	1.50	2.16	2.75	3.27	1.16	1.10	1.96	2.51
" 17..	1.41	1.75	2.56	2.91	1.07	0.89	2.04	2.32
Oct. 1..	——	2.28	2.97	3.14	0.99	1.26	2.57	2.51

The above results seem to show that the fermentation of the

cotton seed and cotton seed meal had very little, if any, effect on the Florida ground phosphate or the South Carolina floats in converting the insoluble into soluble phosphate. The slight variation in the results, though favoring to some extent the conclusion that there is a slight increase in the available phosphoric acid, may be accounted for on the ground of personal error or the want of uniformity in the mixing of the materials, since it is difficult if not impossible to secure perfect uniformity in a mixture of ground phosphate and cotton seed.

AUBURN, Alabama, December, 1892.

PROBLEMS OF PHYSICAL CHEMISTRY.*

By Prof. R. B. Warder.

We may distinguish, at least, four stages or kinds of scientific work, which may or may not be accomplished by the same investigator:

I. The observation and recording of facts; these may be quantitative, as the density of a gas, or qualitative, as the liquefaction of a vapor.

II. The compilation of related facts for further use (tables of constants, for example), together with the critical examination of the discrepancies and trustworthiness of observations.

III. Comparison and discussion of related facts. The observed facts may require reduction or computation in order to make them comparable; as when specific gravities are referred to water at different temperatures, or boiling points are observed under various pressures. Many determinations of speed of chemical action are on record, which have not yet been reduced to a uniform system of units.

IV. The tracing of generalized facts to their cause; first, by scientific use of the imagination in devising an hypothesis, then by subjecting it to the rigorous test of known facts or further experiments. Such was the brilliant work of O. E. Meyer on the kinetic theory of gases.

These various kinds of scientific activity demand very different degrees and kinds of ability; the field is broad and varied enough for all willing workers, even with quite moderate laboratories and libraries, if the work could be properly distributed.

The subject matter of physical chemistry may include all physical properties or phenomena of all kinds of matter in all possible

* Abstract of paper read at the Pittsburgh meeting.

conditions, either passive or active. It includes also the relations of these facts to one another, and the generalizations to be deduced, setting forth the unity of science.

Among the topics in which some progress has been made are:

Nature of matter in general.	Theory of vortex atoms. Kinetic theory of gases. Deviations of actual from the ideal or "perfect" gas. Continuity of gaseous and liquid conditions, as in critical temperature and pressure. Kinetic theory of liquids, especially of solutions. Continuity of liquid and solid conditions, as in viscosity.
Properties of the several chemical bodies.	Periodic law of elements. Mutual attraction, as in capilarity. Freedom of motion, as in viscosity and diffusion. Volume, under varying conditions of temperature and pressure. Refraction, with correction for waves of infinite length. Polarization, in non-isotropic solids. Rotation of plane of polarization, traced to geometrical asymmetry. Simple and harmonic vibrations, as indicated by spectra. Melting and boiling points. Vapor tensions. Solubility. Electrical conductivity and electrolysis. Electro-motive force.

Phenomena of chemical action.
- Influence of mass.
- Speed of reactions.
- Manifestation of energy; as heat, light and electricity.
- Temperature required for limited or complete reaction.
- Conditions of equilibrium.

The foregoing scheme is tentative only; closely related matter being placed under different heads. Still it may help to direct attention to the broader and the subsidiary problems. Among the former are:

I. What is the real nature of matter in atoms and molecules, in elements and compounds, and in the several states of aggregation?

II. How far can the properties of each kind of matter be expressed as a function of the atoms (or other constituents) of which it consists?

III. What are the mechanical possibilities and limitations of chemical change?

If it were possible that physical chemistry should ever become a completed science, we should not only understand the nature of each kind of atom, but we should be able to predict the properties of any possible compound and the manifestations of energy with the conditions of equilibrium in any possible reaction.

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OFFICIAL MILK ANALYSIS IN CANADA.

By Prof. W. H. Ellis.

During the summer of 1887 the Public Analysts of Canada made a number of analyses of samples representing the mixed milk of herds of ows. The cows were milked in the presence of the Analyst and of an officer of the Inland Revenue Department, and duplicate samples taken by them, one of which was examined by the Public Analyst and the other sent to Ottawa and there analyzed by the Chief Analyst, Mr. Macfarlane.

Particular attention was paid to seeing that the cows were milked dry, and that the sample represented the whole milk of the herd. The milk from 167 herds was analyzed, which, if we assume the average number of cows in a herd to be six,* will represent the milk of about a thousand cows.

The Chief Analyst's results were as follows:

	Average.
Solids	12.82
Fat	3.86
Solids not fat	8.96

The examination of the milk from the neighborhood of Toronto fell to my lot. I examined the milk of 37 herds, comprising more than 390 cows. The samples were analyzed by the method pre-

* This is below the truth. The instructions were that no herd of less than four cows was to be examined.

scribed by the Society of Public Analysts for Great Britain (*Analyst*, 1885, p. 46).

The total solids were dried on the water bath in flat bottomed platinum dishes to constant weight.

To determine the fat, milk was run into a stoppered weighing bottle, absorbed by a fat free paper coil, and the quantity of milk absorbed determined by the loss of weight. This coil was then dried in a water oven for one hour, exhausted in a Soxhlet apparatus with light petroleum, the petroleum evaporated and the fat weighed in a light flask after drying to constant weight in a water oven.

My analyses were published in a report to the Canadian government (supplement No. 111 to the report of the Department of Inland Revenue, 1888).

My results may be expressed as follows:

	Total Solids.	Fat.	Solids not fat.
Maximum	13.48	4.87	9.26
Mean	12.27	3.56	8.71
Minimum	10.77	2.70	8.00

The duplicate samples were analysed at Ottawa in the Chief Analyst's laboratory with the following results:

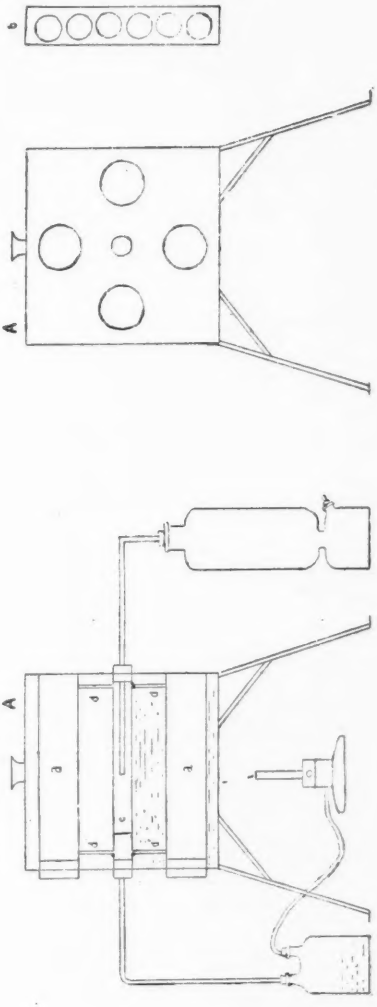
	Total Solids.	Fat.	Solids not fat.
Maximum	13.47	4.50	9.28
Mean	12.08	3.38	8.70
Minimum	10.68	2.52	8.17

The method employed at Ottawa is to weigh the milk into short funnel tubes packed with asbestos, dry in a water oven to get total solids, extract in a Soxhlet or other extraction apparatus large enough to hold several tubes, one above the other, with gasoline, weigh the solids not fat and estimate the fat by difference.

It will be seen that I obtained by the paper method about 0.2% more fat than was got by this asbestos process.

Thinking it desirable to study the effect of drying these finely

divided milk residues under different conditions I devised an oven of which the following is a description:



A is a copper box each side of which measures 9 inches. Four tubes a, a, a, a, run through it from front to back, 2¼ inches diameter. In front they are open and fitted with corks. Behind they are closed. They serve to hold the asbestos drying tubes, which stand in holes in a strip of copper p, which can be pushed into the tubes a.

A fifth tube, c, runs through the centre of the box from front to back.

It is divided near the front by a partition and connected with each of the drying tubes a, by two connecting tubes d, d^1, one in front of the partition and the other behind it and near the back. Both ends of the tube c are open and fitted with corks. The hinder cork carries a glass tube, which runs almost to the partition and is connected behind with a drying arrangement. The front cork carries a glass tube, which is connected with a Woulf's bottle.

To use the oven with hydrogen the gas is aspirated from a gas-holder through the drying apparatus into the tube c, where it becomes heated; thence it passes into the drying tubes a by the connecting tubes d; there it passes over the samples and back again into c, in front of the partition, by the connecting tubes d^1; thence it passes to the Woulf's bottle, where it deposits most of its moisture and thence to a second gas holder.

With coal gas a drying apparatus is connected with the supply, and the Woulf's bottle is connected with a Bunsen burner beneath the oven, where the gas is burned, serving to boil the water in the oven.

Mr. W. Lawson, a student in my laboratory, has made the following determination with this apparatus:

Eighteen samples of the same milk were weighed out into asbestos tubes at the same time, and within the same hour six of them were put into an ordinary water oven, six into an oven filled with hydrogen, and six into an oven filled with coal gas.

The results were as follows:

Total Solids.

In Air.		In Coal Gas.		In Hydrogen.	
No. 1	12.212	No. 7	12.058	No. 13	11.979
2	12.235	8	12.078	14	11.997
3	12.256	9	12.072	15	11.949
4	12.222	10	12.005	16	11.959
5	12.251	11	12.019	17	11.998
6	12.239	12	12.031	18	12.049
Mean	12.235	Mean	12.044	Mean	11.988

Solids not Fat after Extraction with Gasoline.

Air.		Coal Gas.		Hydrogen.	
No. 1	8.821	No. 7	8.521	No. 13	8.432
2	8.845	8	8.525	14	8.446
3	8.866	9	8.544	15	8.396
4	8.846	10	8.521	16	8.415
5	8.913	11	8.543	17	8.429
6	8.877	12	8.509	18	8.489
Mean	8.861	Mean	8.527	Mean	8.434

Fat (by Difference).

Air.		Coal Gas.		Hydrogen.	
No. 1	3.391	No. 7	3.537	No. 13	3.547
2	3.390	8	3.553	14	3.551
3	3.390	9	3.528	15	3.553
4	3.376	10	3.484	16	3.544
5	3.338	11	3.476	17	3.569
6	3.362	12	3.522	18	3.560
Mean	3.374	Mean	3.517	Mean	3.554

Five determinations of the fat were then made by the Werner-Schmidt method, with the following results:

	Fat per cent.
No. 1	3.543
2	3.560
3	3.618
4	3.539
5	3.595
Mean	3.571

Comparing the averages of these fat determinations we get:

In air by asbestos	3.374	per cent.
In coal gas, by asbestos	3.517	"
In hydrogen, "	3.554	"
By Werner-Schmitt Method	3.571	"

The average percentage of fat in coal gas and hydrogen is	3.536
The average in air is	3.374
A deficiency of	.162
The average total solids in air are	12.235
In hydrogen and coal gas	12.016
An excess of	.219
The solids not fat in air are	8.861
In hydrogen and coal gas	8.480
An excess of	.381

It appears, then, from these experiments that by long drying in the air at the temperature of the water oven, the milk solids undergo changes by which the total solids increase in weight 1.8% and the portion insoluble in gasoline increases in weight 4.3%, while the fat, as determined by difference, loses 4.5%, a part of it apparently becoming insoluble in gasoline.

The asbestos method as used by Mr. McFarlane is, in my judgment, the most simple and rapid gravimetric process at our disposal for the analysis of a number of samples at once. By drying in purified coal gas, in an apparatus such as I have described, it may be made without materially interfering with its simplicity, also, one of the most accurate.